

# **Identification and Evaluation of School Bus Route and Hazard Marking Systems**

**Final Report**

**Work Performed Under a Grant From  
The National Highway Traffic Safety Administration  
U.S. Department of Transportation**

**Grant # DTNH22-97-G-05155**

**June 1998**

**National Association of State Directors of Pupil Transportation Services  
116 Howe Drive  
Dover, DE 19901**

**Identification and Evaluation  
of  
School Bus Route and Hazard Marking Systems**

**NHTSA Grant # DTNH22-97-G-05155**

**National Association of State Directors of Pupil Transportation Services**

**Background:**

An estimated 23 million public school students ride over 400,000 school buses twice daily to go to and from school. Additionally, it has been estimated that another one to two million students ride school buses to and from school-related activities each day. In the course of a school year, school buses transport students over four billion miles. The safety of pupil transportation is of significant concern to Federal, State and local governments, school districts, school administrators, parents, and the general public.

Within the school transportation industry itself, there is a long history of significant efforts to make school transportation safe and efficient. Pupil transportation programs date back to the earliest years of the 20<sup>th</sup> century. By 1910, thirty states had pupil transportation programs in place. The first “vehicles” used to transport students were nothing more than horse-drawn carts which were borrowed from local farmers. With the development of automobiles and trucks with gasoline-powered engines, the school “wagon” was replaced with the school “truck.” During the 1920's and 1930's, the Nation's roadway system was expanding, especially in rural communities. This led to a greater need for vehicles to transport school children and the formation of an industry of school bus manufacturers.

As the number of school buses operating on the roadways increased, there came the inevitable problems. Several serious tragedies occurred involving school buses which caused school officials to think seriously about developing safety guidelines for school buses. In 1939, representatives from 48 states gathered to develop recommendations for school buses. Since that time, there have been a total of 12 National Conferences on School Transportation where representatives from each state gather to revise existing and establish new safety guidelines for school buses and operating procedures for the safe transportation of school children, including those with disabilities. The product of these national conferences are referred to as the National Guidelines for School Transportation. The National Conferences are jointly sponsored by the National Association of State Directors of Pupil Transportation

Services (which includes the School Bus Manufacturers Technical Council), the National Association for Pupil Transportation, and the National School Transportation Association, the National Safety Council, and Central Missouri State University.

To help ensure the transportation safety of students on school buses, the National Highway Traffic Safety Administration (NHTSA) establishes and enforces a series of Federal Motor Vehicle Safety Standards governing the safety performance and manufacture of school buses. NHTSA also conducts a safety defects investigation program to identify safety defects in motor vehicles, including school buses, and requires manufacturers to recall and remedy defective vehicles free of charge. In addition, NHTSA's Guideline #17, "Pupil Transportation Safety," establishes minimum recommendations for a pupil transportation safety program, including the identification, operation, and maintenance of buses used for transporting students; training of passengers, pedestrians, and bicycle riders; and administration.

Even with the school bus-specific Federal Motor Vehicle Safety Standards, NHTSA's safety defect investigation and recall program, NHTSA's Guideline #17, and the school transportation industry's National Guidelines for School Transportation, a few school bus safety problems continue to persist. One of these problems was identified as a contributing factor in a tragic crash that occurred on October 25, 1995, in Fox River Grove, Illinois. On that day, a commuter train hit a school bus that was stopped at a highway-railway grade crossing. Seven students were killed and the school bus driver and 24 other students were injured. The school bus driver had taken all of the appropriate actions prior to crossing the railroad tracks, but unknowingly failed to completely clear the railway track while the school bus was stopped at a red traffic light. The commuter train struck the rearmost side of the school bus.

At the conclusion of its investigation of the crash, the National Transportation Safety Board identified one of the factors contributing to the crash as an inadequate school district routing and hazard marking system. The Safety Board noted that the substitute school bus driver operating the bus that day was unaware of the hazard at the highway-railroad crossing because "the methods employed by the school district to identify and evaluate route hazards were ineffective."

In addition to the Safety Board's investigation of the Fox River Grove crash, the U.S. Department of Transportation formed a Grade Crossing Task Force to review the decision-making process for designing, constructing, and operating rail crossings. The Task Force published its findings in a March 1996 report, *Accidents That Shouldn't Happen*. One recommendation from that report calls for NHTSA to "work with State directors of pupil transportation, through relevant national organizations, to develop a system to improve school bus routing safety by focusing on highway-railroad grade crossings."

As a result of the recommendations from the Safety Board and the Grade Crossing Task Force, NHTSA provided a grant to the National Association of State Directors of Pupil Transportation Services to:

1. Research the issue of school bus route hazards and route hazard marking systems;
2. Develop a set of guidelines that school transportation officials could utilize in developing a system for identifying school bus route hazards that meets the needs of their locality;
3. Provide suggestions for reasonable and appropriate means of informing school bus drivers of potential school bus route hazards so as to educate them on how to deal with any route hazards that can not be avoided; and
4. Suggest methods to disseminate the information developed during this project to the school transportation community.

### **School Bus Driver Training**

School bus driver training is one of the most important components of the school bus transportation system. A critical component of school bus driver training is the recognition of potential driving hazards and appropriate adjustment of driving behavior to ensure the safety of the school bus occupants. The goal of this project and report is to provide school bus drivers and substitute drivers with a list of locations/situations that should be recognized as being potentially hazardous. School bus drivers should be properly trained to deal with

these potentially hazardous conditions. In addition, school bus drivers should be trained to deal with hazardous conditions that occur suddenly or are of a temporary nature. Constant dialogue between school bus drivers and route planners is critical to ensure the continued safe transportation of students in school buses.

## **Methodology:**

The National Association of State Directors of Pupil Transportation Services undertook the following activities to develop a school bus route hazard identification system and a means of educating school bus drivers about such hazards. Each of the activities included review and comment by the various state directors of pupil transportation. Throughout this report, specific comments from states are included to illustrate the involvement and insight provided by the state directors.

### **1. Define “School Bus Route Hazard”**

The first, and most critical, step was to develop an acceptable and reasonable definition of what constitutes a “school bus route hazard.” From a practicable perspective, “school bus route hazards” can be grouped into two distinct categories. First, there are “driving hazards” that are encountered while operating a school bus route, such as railroad grade crossings and industrial intersections. Second, there are “school bus loading zone hazards” that are encountered at a school bus stop, such as a narrow, busy street without sidewalks or dangerous curves that do not provide the school bus driver, the students, or other motorists with an adequate view of the school bus loading zone. The scope of work for this project only included the first category of school bus route hazards -- driving hazards.

### **2. Develop a “Model” School Bus Route Hazard Identification System**

Based on the knowledge and expertise of individuals within the school transportation industry, an ideal program that could be used to assist states and local school districts in identifying and evaluating potential school bus route hazards was defined. This

ideal program became the “model” against which existing school bus route hazard identification programs were compared.

### **3. Review Existing Materials/Information**

Examples of existing state or local school district route hazard identification programs were reviewed and compared with the “model” system described above. The existing programs were reviewed in terms of the ability of the program to identify route hazards and communicate that information to the appropriate individuals.

### **4. Develop a Recommended System**

Based on the review of existing programs, as compared to the “model” system, a recommended school bus driving route hazard identification system was developed that could provide states and local school districts with an efficient method for identifying potential school bus route hazards and a means of communicating information about those hazards to school bus drivers and trainers, route planners, and other appropriate school transportation officials.

### **5. Dissemination Approaches**

Finally, suggestions were made on how to disseminate the “recommended” system to the school transportation community, and what approaches should be taken to educate state and local school transportation providers on the importance of adopting such a school bus driving route hazard identification system.

## **Results of Program Activities:**

### **Result #1 -- Definition of a School Bus Route Driving Hazard**

While it is possible to develop a list of the potential hazardous locations/situations that a school bus driver could encounter in the course of driving a school bus route, it is not possible to develop a definitive list of every potential driving hazard. As was pointed out

by the state of Indiana during discussions of this project, “Regular review of the route hazards list is encouraged. This will keep the document accurate and permit the addition of ‘yet-to-be-discovered’ hazards.”

Some potential school bus route driving hazards can be considered as “fixed,” in that the situation or condition exists (such as a railroad crossing), can be identified, and drivers can be informed and educated about the potential hazard. Other potential driving hazards occur without advanced warning -- examples include: (1) inclement weather conditions, such as fog, sand storms, blinding sunlight, snow storms, etc.; (2) conditions that result from weather conditions, such as flooded roadways, fallen trees, downed power lines; and (3) accident locations. This report focuses on potential school bus route driving hazards that are of a “fixed” nature.

## **Discussion**

Table 1 details many of the potentially hazardous locations/situations that a school bus driver could encounter in the course of driving a school bus route. These potential driving hazards were selected based on the belief that the mere existence of any one of these conditions poses possible serious consequences if the school bus driver is not aware of the existence of the hazard. While a hazard could develop at any time while driving a school bus (for example, a tree could fall across a road during a storm, or a stream could overflow, or a wet road could suddenly ice over), this list defines only fixed conditions that, by their presence, have been deemed a potential driving hazard. Also, this list is limited to the hazardous locations/situations encountered while driving the school bus, not during loading and unloading operations.

For each potential school bus route driving hazard, a list of factors or situations that could contribute to causing the hazard is provided. It is important to remember that this list of potential school bus route driving hazards, and the factors/situations within them, is not “all-inclusive.” States and local school districts may encounter factors and situations that are not listed in Table 1, but which they deem are potentially hazardous.

**Table 1.**  
**List of Potentially Hazardous Locations/Situations on School Bus Routes**

**Railroad Grade Crossing**

- Number of tracks
- Visual obstructions to determine type and travel speeds of trains
- Train schedules (consider unscheduled trains also)
- Presence or absence of grade crossing controls
- Unique characteristics or operation of grade crossing controls
- Presence or absence of traffic control signals, including interaction with grade crossing controls
- Size of queuing area before and after the tracks
- Expected traffic conditions at various times during the day
- Roadway design near the grade crossing

**Dangerous Intersections and Roadways**

- High-frequency crash locations as defined by state transportation and/or law enforcement officials
- Uncontrolled intersections
- Curves and intersections with limited sight distances
- Areas with no shoulders
- Visibility of traffic control signals
- Coordination of traffic control signals with others in the immediate area

**Bridges, Tunnels/Underpasses and Overpasses**

- Weight capacity
- Height clearances
- Lane width



### **Queuing/Storage Areas**

- Short acceleration/deceleration lanes
- Limited median areas crossing multi-lane highways
- Turning lanes

### **Industrial Intersections and Construction Zones**

- Areas where heavy vehicles/equipment operate on a regular basis, and may be entering, exiting, or crossing the roadway

### **Steep Downgrades**

- Mountainous areas where brake condition and braking operations are important
- Location of out-of-control vehicle run-off areas

### **Areas of Significant Speed Differential Between Vehicles**

- On-off ramps to high-speed roads
- Farm vehicle areas, including non-motorized vehicles on the road
- Mountain terrain

### **Pedestrian Areas**

- School bus loading/unloading zones
- Narrow streets with parked motor vehicles – children darting between vehicles
- Congested shopping and business areas

### **Other Conditions Identified in Local Area**

- Unique roadway locations, for example;
  - roadways without guardrails that are next to rivers, lakes, etc.
  - dirt or gravel roads that could affect braking

- Rock quarry or open pits
- Areas with problems related to right-turn-on-red laws
- Areas with visibility problems due to air quality/industrial smoke/etc.
- Areas where emergency equipment operate on a regular basis
  - fire stations
  - hospitals

## **Result #2 -- Development of a “Model” School Bus Route Hazard Identification System**

During the course of this project, a “model” school route hazard identification system was outlined. It was recognized that such a system would consist of three major components:

1. A list of potential driving hazards;
2. A specified procedure/schedule for conducting on-site reviews of school bus routes; and
3. An efficient and effective means of informing school bus drivers of the presence of potential driving route hazards.

Of the three components, the first was determined to be the most critical, since without a definition of what constitutes a school bus route driving hazard, the other components would have little utility. Additionally, developing a procedure and schedule for reviewing school bus routes and an information dissemination plan were viewed as administrative policy decisions that were independent of the technical issues related to identifying potential school bus route driving hazards. Accordingly, the focus of the effort was placed on identifying and listing potential school bus route driving hazards.

An initial list of potential hazards was prepared during a Working Session of state directors during the 1997 annual conference of the National Association of State Directors of Pupil Transportation Services. The results of that session were summarized and provided for review to all state directors of pupil transportation. The final results of that effort are discussed in the previous section of this report, “Result #1 – Definition of a School Bus Route Driving Hazard.”

### **Result #3 -- Review of Existing Materials/Information**

A review of existing school bus route hazard identification systems was made to see if any system assessed all of the potential driving hazards developed during the Working Session at the 1997 annual conference. Not one was found. However, this effort identified additional potential hazards that were not previously considered, but were ultimately included in the final list of school bus route driving hazards as defined in Result #1 above.

### **Result #4 -- Defining a Route Hazard Identification System**

The major goal of this project was to develop a system that a state or a local school district could use to:

1. Identify any fixed locations/situations that constitute a potential school bus driving hazard; and
2. Inform school bus drivers and substitute drivers of each identified potential route hazard on the school bus route(s) they drive.

#### **Identification**

The first component of such a system would consist of an established, systematic process to evaluate all school bus routes to determine whether any potential fixed driving hazards exist. An annual review of each school bus route by a person trained to identify potential route driving hazards would provide the basis for identifying any potential hazards. In addition, school bus drivers should be trained in how to recognize a potential school bus route driving hazard, and to report any new potential hazardous conditions to the appropriate school transportation officials. In effect, this would provide for continual monitoring and review of school bus routes so school bus drivers are aware of all potential fixed driving hazards on their routes. As stated by Connecticut, “constant communication between school bus drivers and route planners is critical to safety.” Hazards can and do change, even on a daily basis. As

such, “daily updates of critical route hazards should be foremost in the minds of dispatchers and drivers.”

A checklist format based on the above list of potential school bus driving route hazards (Result #1 -- Table 1) would provide for a consistent means of ensuring that such items were considered during the review of each school bus route. An example of such a checklist for the items identified in Result #1 appears as Appendix A to this report, and is based on a format utilized in Oklahoma. It is important to remember that a state or a local school district should ensure that any potential hazards that may be unique to their area, or any potential hazards that they believe were missing, are added to the checklist.

In addition to regular school bus routes, there also can be potential driving hazards along routes taken for field trips or extra-curricular activities. In such cases, drivers may be able to identify potential route driving hazards based on their personal knowledge of the route or on a previous trip to the same location.

## **Information**

The second component of a school bus route driving hazard identification system consists of a means of informing all regular and substitute school bus drivers of the potential driving hazards on their school bus route(s). New Jersey stressed the importance of “the need for drivers and driver trainers to make clear notes of these hazards for all substitute drivers.”

In addition to the drivers, school bus route planners/schedulers/dispatchers/etc. should be made aware of all information about potential driving hazards on the school bus routes. This information would allow them to make changes or adjustments to the routes, when reasonable and practicable, so as to minimize or eliminate the exposure of school buses to these route driving hazards.

Informing the necessary people about potential school bus route driving hazards can be accomplished in a number of ways. The most practical, and possibly most easily

understandable, appears to be through the use of a map that is visually annotated to identify potential route hazards. The same map could obviously be used for other purposes, including designating the actual school bus route and student pickup/drop off locations. Additionally, as the states of Ohio and Virginia noted in their comments to this project, information on the location of police/fire/rescue stations, hospitals, and other emergency care facilities, and “possible ‘safe stops’ where a school bus may pull off the road and await aid in the event of an emergency” could be added to the map.

A number of local school districts currently use mapping techniques to document the streets in their district, the location of the students’ homes, the school bus stops, and the routes traveled by school buses. Inexpensive color printers allow school districts to print color maps of their bus routes, and computer software allows route planners to incorporate custom information, such as route hazards, on the map.

Whatever means is chosen, it is important that school bus drivers be provided with route hazard information in a standardized, consistent manner. Also, the route hazard information should be available to the school bus driver every day, no matter which school bus is driven on that day.

## **Training**

While not a specific part of this project, the importance of training school transportation providers about school bus route driving hazards can not be understated. In their comments, Ohio noted that the contents of a route hazard identification system are “only good if utilized.” In other words, if drivers are not made aware of the potential driving hazards and trained on how to deal with such potential hazards, then no benefits will accrue from efforts to identify potential route hazards. Mississippi commented that its training in route hazards constantly works “to instill in each driver the concept of Expect the Unexpected.”

However, training alone does not guarantee success. As Connecticut stated, “Route hazards is an area in which some training can be afforded, but common sense and

networking among drivers, local officials, and school district personnel is paramount to a safe and successful route hazard notification program.”

## **Result #5 -- Dissemination Approaches**

Based on the belief that the ultimate success of a school bus route driving hazard identification system is dependent on the awareness and use of the system by school transportation providers, it is strongly suggested that the results of this project be provided to all state directors of pupil transportation, the appropriate student transportation officials in each school district, and organizations affiliated with private/parochial schools. The dissemination to state directors and public schools districts could be made by use of direct mailings. The dissemination to private/parochial schools could be made through national associations that represent such schools.

As a supplement to direct mailings, the report on this project should be made available on the NHTSA and various school transportation web sites in a form that can be downloaded. In addition, the results of this project should be publicized through the various media that deal with pupil transportation.

## **Non-Fixed School Bus Route Hazards:**

As mentioned earlier, this project only dealt with school bus route driving hazards that are “fixed.” However, it is recognized that other driving hazards can occur without advanced warning. These often result from inclement/adverse weather conditions or poor visibility conditions. It is important for school bus drivers to be aware of such possibilities and be trained on how to deal with such sudden potential hazards. As an example of some non-fixed driving hazards, Iowa includes in its School Bus Driver’s Handbook procedures to follow should a school bus encounter a tornado or Agri-Chemical clouding along school bus routes. Also, Delaware provides drivers with information in its School Bus Driver’s Handbook to prepare them for the following:

#### Adverse weather conditions

- Extreme cold
- Extreme heat
- Wind
- Rain
- Fog
- Snow/ice

#### Conditions affecting visibility

- Sun glare
- Darkness
- Fog/rain/snow
- Curves and hills

Wild animals are another example of a non-fixed school bus route driving hazard. In many rural and suburban areas, animals such as deer and live stock can be a serious danger to motorists. School bus drivers should be made aware of such situations and learn how to deal with them.

### **Conclusions:**

Recognizing the importance of identifying school bus route driving hazards, the National Association of State Directors of Pupil Transportation Services has conducted this study for the National Highway Traffic Safety Administration. Verbal and written information from members of the Association was consolidated to focus on the key issues and the best approach for addressing the problem of driving hazards on school bus routes. The following conclusions were reached during the study:

- Driving hazards can and do exist on school bus routes.
- Driving hazards on school bus routes that are of a “fixed” nature can be identified.
- School transportation officials should establish a program to routinely and systematically evaluate all school bus routes for potential driving hazards.

- A list of potential fixed school bus route driving hazards has been developed for use in evaluating school bus routes.
- Information on potential school bus route driving hazards should be provided to all regular and substitute school bus drivers, route planners, dispatchers, and other appropriate personnel.
- School bus drivers should be trained on how to effectively deal with potential school bus route driving hazards, of both a fixed or sudden nature.
- The results of this project should receive wide dissemination.

The National Association of State Directors of Pupil Transportation Services encourages states, local school districts, and private/parochial schools to review this report in conjunction with their school transportation operations and take whatever actions are necessary to ensure that school bus route driving hazards are identified and made known to all appropriate school bus drivers and school transportation personnel.



## Appendix A

### Checklist for Identifying Potential School Bus Route Fixed Driving Hazards

#### Railroad Grade Crossings

Railroad Grade Crossing Identification Number \_\_\_\_\_

Location \_\_\_\_\_

How many tracks are present? \_\_\_\_\_

What are the times of the scheduled trains? \_\_\_\_\_

What types of trains use the track?    Passenger \_\_\_\_ Freight \_\_\_\_ Commuter \_\_\_\_

What are the travel speeds of the scheduled trains? \_\_\_\_\_

- |   | Yes   | No    |
|---|-------|-------|
| • Are the regulatory signs (crossbucks) clearly visible?                          | _____ | _____ |
| • Are there regulatory devices (lights/gates/bells) present?                      | _____ | _____ |
| • Are there any unique characteristics to the operation of the crossing controls? | _____ | _____ |

What are they? \_\_\_\_\_  
\_\_\_\_\_

- |  |       |       |
|--|-------|-------|
| • When stopped approximately 15 feet from the nearest railroad track, is there an unobstructed sight distance of approximately 1,000 feet in both directions?        | _____ | _____ |
| • Is there at least enough room on the other side of the furthest railroad track for the largest school bus to stop without encroaching on the train's right-of-way? | _____ | _____ |
| • Are there any roadway design features that could affect the safe operation of a school bus at the railroad crossing?   | _____ | _____ |

What are they? \_\_\_\_\_  
\_\_\_\_\_

## Appendix A – Continued

### Dangerous Intersections and Roadways

Location \_\_\_\_\_

	Yes	No
• Is this a high-frequency crash location?	_____	_____
• Are traffic control devices present?	_____	_____
• Are there visibility obstructions?	_____	_____
What are they? _____ _____		
• Are there areas with no shoulders?	_____	_____
• Are there peculiar roadway features?	_____	_____
What are they? _____ _____		

## Appendix A – Continued

### **Bridges, Tunnels/Underpasses and Overpasses**

Location \_\_\_\_\_

	Yes	No
• Is the weight capacity of the bridge/overpass sufficient for a fully-loaded school bus?	_____	_____
• Is the height of the tunnel/underpass adequate for the tallest school bus, including open roof hatches?	_____	_____
• Is the lane width of the bridge, tunnel/underpass, or overpass adequate for the widest school bus, including the mirrors?	_____	_____

## Appendix A – Continued

### Queuing/Storage Areas

Location \_\_\_\_\_

	Yes	No
• Is there sufficient area for the largest school bus in the acceleration/deceleration lane?	_____	_____
• Is there sufficient area for the largest school bus in the median area between a multi-lane road?	_____	_____
• Is there sufficient area for the largest school bus in the turning lane?	_____	_____

## Appendix A – Continued

### Industrial Intersections and Construction Zones

Location \_\_\_\_\_

	Yes	No
• Do heavy vehicles enter/exit/cross the roadway frequently?	_____	_____
• Are there highway signs alerting drivers of the industrial/construction traffic?	_____	_____
• Are there traffic controls in the area?	_____	_____

## Appendix A – Continued

### Steep Downgrades

Location \_\_\_\_\_

	Yes	No
• Are there highway signs alerting drivers to the downgrade?	_____	_____
• Are there signs alerting drivers to “Check Brakes”?	_____	_____
• Are there areas marked and designated for vehicles to safely leave the road (run-off areas)?	_____	_____

## Appendix A – Continued

### Areas of Significant Speed Differential Between Vehicles

Location \_\_\_\_\_

	Yes	No
• Is there sufficient space to accelerate/decelerate a school bus when entering/exiting a high-speed road?	_____	_____
• Does slow-moving farm equipment operate on the road?	_____	_____
• Do non-motorized vehicles, e.g., horse-drawn carriages, operate on the road?	_____	_____
• Are there roadway conditions, e.g., mountainous terrain, that result in vehicles operating at high speeds and low speeds?	_____	_____
What are they? _____		
_____		

## Appendix A – Continued

### Pedestrian Areas

Location \_\_\_\_\_

	Yes	No
• Are there difficulties seeing pedestrians at school bus stops?	_____	_____
• Are there narrow streets with parked vehicles where children may run into the street?	_____	_____
• Are there areas of heavy pedestrian congestion, e.g., shopping and business areas?	_____	_____



## Appendix A – Continued

### Other Conditions Identified in Local Area

Location \_\_\_\_\_

Yes

No

- Are there unique roadway conditions?

- roads without guardrails that pose a danger, e.g., next to rivers, lakes, quarries?

---

---

- dirt or gravel roads that could affect braking?

---

---

- Others?

\_\_\_\_\_

[illegible]

What are they? \_\_\_\_\_

---

- Are there roadway conditions that make it difficult to make a “right turn on red?”

---

---

What are they? \_\_\_\_\_

---

- Are there areas with visibility problems due to industrial smoke, air quality, etc.?

---

---

- Are there areas where emergency equipment operate on a regular basis, e.g., fire stations or hospitals?

---

---